70527-23607

[Name of Document] SPECIFICATION

[Title of Invention] Master Information Carrier for Magnetic Transfer

[Scope of Demand for Patent]

1. A master information carrier for magnetic transfer having on a surface thereof an uneven pattern representing information to be magnetically transferred to a magnetic recording medium held in contact with the surface of the master information carrier, characterized by

the parts of the surface of the master information carrier which are brought into contact with the magnetic recording medium being in the range of 0.3nm to 10.0nm in center plane mean surface roughness SRa.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to a master information carrier for magnetic transfer carrying thereon an uneven pattern representing information to be transferred to a magnetic recording medium.

[0002]

[Description of the Related Art]

With an increase in information quantity, there is a demand for a magnetic recording medium which is high in memory capacity, low in cost and preferably requires a short time to read out a necessary part of data (a magnetic recording medium which allows

so-called high-speed access). As an example of such a magnetic recording medium, there has been known a high recording density magnetic medium comprising a flexible disc such as a hard disc, a zip (Iomega) and the like. In such a high recording density magnetic medium, the data recording area is formed by narrow data tracks. In order to cause a magnetic head to accurately trace such narrow data tracks and reproduce signals at a high S/N ratio, the so-called servo tracking technique has been employed.

[0003]

In order to perform the servo tracking, it is necessary to write servo information such as servo tracking signals for positioning the data tracks, address signals for the data tracks and reproduction clock signals on the magnetic recording medium in advance as a preformat upon production thereof. At present, such preformat recording is performed by the use of a specialized servo recording apparatus (a servo track writer). However, the preformat recording by the conventional servo recording apparatus is disadvantageous in that it takes a long time since the servo information must be recorded on the magnetic recording medium one by one by the use of a magnetic head, which deteriorates the productivity.

[0004]

As a method of recording the preformat accurately and efficiently, there has been proposed, for instance, in Japanese Unexamined Patent Publication Nos. 63(1988)-183623, 10(1998)-40544 and 10(1998)-269566, a magnetic transfer method in which a pattern

which is formed on a master information carrier and represents servo information is copied to a magnetic recording medium by magnetic transfer.

[0005]

In the magnetic transfer, the magnetization pattern representing the information carried by a master information carrier is magnetically transferred from the master information carrier to a magnetic recording medium (a slave medium) by applying a transfer magnetic field to the slave medium and the master information carrier carrying information to be transferred being in a state of close contact with each other, and accordingly, the information carried by the master information carrier can be statically recorded on the slave medium with the relative position between the master information carrier and the slave medium kept constant. Thus, according to the magnetic transfer, there are advantages that the preformat recording can be performed accurately and the time required for the preformat recording is very short.

[0006]

[Problems to be solved by the Invention]

The present applicants have proposed in Japanese Unexamined Patent Publication No. 2001-14667 a method of magnetic transfer in which a master information carrier for magnetic transfer, which comprises: a substrate, on a surface of which the uneven pattern corresponding to the information to be transferred is formed; and a magnetic layer, having a small magnetic coercive force, formed on the surface of the protruding portions of the substrate, is

employed. After initially DC-magnetizing a magnetic layer of a slave medium in advance in one direction of the recording tracks, a transfer magnetic field is applied to the slave medium in the direction opposite to the direction of the initial-DC-magnetization with the magnetic layer of the slave medium held in close contact with the magnetic layer of the master information carrier.

[0007]

In order to improve the transfer quality (the quality of the signal transferred to the slave medium) in the above magnetic transfer, it is necessary for the space between the master information carrier and the slave medium to be uniform. Since it is difficult to uniformly space the master information carrier and the slave medium over the entire area of the slave medium, the master information carrier and the slave medium are generally brought into close contact with each other. Also in the case where the master information carrier and the slave medium are brought into close contact with each other, it is important that they are uniformly brought into close contact with each other over the entire areas thereof. That is, when the slave medium is unsatisfactorily brought into close contact with the master information carrier at a portion thereof, the intensity of the magnetic field becomes non-uniform in the transfer magnetic field around this portion and non-uniformity of magnetization can occur in an area of magnetic transition or in an area of magnetic uniformity. As a result, the quality of the transferred signal deteriorates and in the case where the recorded signal is a servo signal, satisfactory tracking function cannot be

obtained on the slave medium, which deteriorates the reliability of the slave medium.

[0008]

In view of the foregoing observations and description, the primary object of the present invention is to provide a master information carrier for magnetic transfer which can suppress transfer defects such as signal drop-out in the magnetic recording medium transferred with a magnetization pattern by magnetic transfer and improve the quality of the transferred signal.

[0009]

[Means used to solve the Problems]

In accordance with the present invention, there is provided a master information carrier for magnetic transfer having on a surface thereof an uneven pattern representing information to be magnetically transferred to a magnetic recording medium held in contact with the surface of the master information carrier, characterized by:

the parts of the surface of the master information carrier which are brought into contact with the magnetic recording medium being in the range of 0.3nm to 10.0nm in center plane mean surface roughness SRa.

[0010]

The "center plane mean surface roughness SRa" is a three-dimensional mean roughness with respect to a center plane (a plane which defines the same volumes on opposite sides thereof together with the profile of the master information carrier) and

is obtained by averaging deviations from the center plane as represented by the following formula.

[0011]

[formula 1]

$$SRa = \frac{1}{LxLy}\int_0^{Ly}\int_0^{Lx}\left|f(x,y)\right|dxdy$$

wherein Lx and Ly represents the dimensions of the surface in x- and y-directions and f(x,y) represents a roughness surface to the center plane.

[0012]

The center plane mean surface roughness SRa is preferably in the range of 0.5nm to 5.0nm and more preferably in the range of 0.5nm to 3.0nm.

[0013]

The "the parts of the surface of the master information carrier which are brought into contact with the magnetic recording medium" include not only the top surface of the protruding portions of the uneven pattern but also a part which is not provided with the uneven pattern on the surface but brought into contact with the magnetic recording medium.

[0014]

In the case where the master information carrier for magnetic transfer of the present invention comprises a substrate and a magnetic layer formed at least on the protruding portions of the uneven pattern on the substrate, the center plane mean surface roughness SRa can be controlled by controlling magnetic layer forming

conditions such as the flow rate of Ar, the output power and/or the film forming thickness during sputtering. For example, when the flow rate of Ar during sputtering is increased, the center plane mean surface roughness SRa can be increased, whereas when the flow rate of Ar during sputtering is decreased, the center plane mean surface roughness SRa can be decreased. When the film forming thickness is increased, the surface is more roughened, and when the film forming thickness is decreased, the surface is smoothed.

[0015]

Further, in the case where the uneven pattern of the substrate of the master information carrier is formed in the steps including patterning of photoresist by lithography and removal (washing) of photoresist, residual photoresist remaining on parts which finally become top surfaces of the protruding portions of the substrate affects the center plane mean surface roughness of the top surfaces of the protruding portions, and accordingly, the center plane mean surface roughness SRa can be controlled by controlling the degree of washing of the photoresist. For example, by enhancing the degree of washing of the photoresist, the center plane mean surface roughness SRa can be reduced.

[0016]

[Advantageous Effects of the Invention]

When the parts of the surface of the master information carrier, which are brought into contact with the magnetic recording medium that serves as the slave medium, is in the range of 0.3nm to 10.0nm in center plane mean surface roughness SRa, the slave medium and

the master information carrier can be uniformly brought into close contact with each other in part or whole and non-uniformity in transferred magnetization and deterioration in linearity of transferred magnetization can be prevented, whereby excellent transfer recording properties can be obtained.

[0017]

That is, if the parts of the surface of the master information carrier, which are brought into contact with the slave medium, are greater than 10.0nm in center plane mean surface roughness SRa, the master information carrier cannot be brought into satisfactory close contact with the slave medium and a transfer magnetic field distribution is generated, which causes transfer defects and deteriorates the quality of transfer. If the parts of the surface of the master information carrier, which are brought into contact with the slave medium, are smaller than 0.3nm in center plane mean surface roughness SRa, air traps can be generated when the master information carrier is brought into close contact with the slave medium and a local transfer magnetic field distribution is generated, which causes transfer defects and deteriorates the quality of transfer. However, if the parts of the surface of the master information carrier which are brought into contact with the slave medium are in the range described above in center plane mean surface roughness SRa, favorable transfer can be accomplished.

[0018]

[Description of the Preferred Embodiment]

An embodiment of the present invention will be described in

detail below. Figure 1(a) is a top plan view showing a master information carrier for magnetic transfer 3 of the present invention. Figure 1(b) is a cross-sectional view taken along line I-I in Figure 1(a).

The master information carrier 3 having the uneven pattern corresponding to the information to be transferred to the magnetic recording medium that serves as a slave medium on its surface, transfers the information to the slave medium by applying a magnetic field to the master information carrier 3 and the slave medium held in close contact with each other. The parts 3a of the surface of the master information carrier 3 which are brought into contact with the slave medium 2 (will be referred to as "the contact parts 3a", hereinbelow) are in the range of 0.3nm to 10.0nm in center plane mean surface roughness SRa. When the center plane mean surface roughness SRa of the contact parts 3a is larger than 10.0nm or smaller 0.3nm, the master information carrier and the slave medium cannot be brought into satisfactory close contact with each other in part or whole and accordingly, the quality of the transferred signal deteriorates.

[0019]

The master information carrier for magnetic transfer may be formed of any suitable material or by any suitable method so long as the center plane mean surface roughness SRa of the contact parts 3a is not smaller than 0.3nm and not larger than 10.0nm.

[0020]

As shown in Figure 1(a), the master information carrier 3 is

formed to be of a discoid shape. The donut-like area circumscribed the dotted line in this Figure is a transfer area 10 where an uneven pattern representing information to be transferred to the slave medium is formed, and the inner and outer areas of the transfer area 10 are non-transfer areas 11 and 12 carrying thereon no information to be transferred to the slave medium.

[0021]

As shown in Figure 1(b), the non-transfer areas 11 and 12 are substantially flush with the protruding portions of the uneven pattern formed in the transfer area 10. Accordingly, the inner and outer non-transfer areas 11 and 12 are bought into contact with the slave medium as well as the upper surfaces of the protruding portions of the uneven pattern at the contact parts 3a. The center plane mean surface roughness SRa of the contact parts 3a is set in the range of 0.3nm to 10.0nm. Although the slave medium 2 is shown by broken lines on the master information carrier 3 in Figure 1(b), actually the slave medium 2 is held in close contact with the master information carrier 3 when a magnetic field is applied and the magnetic transfer is carried out. The slave medium 2 which is a magnetic transfer medium is, for instance, a discoid magnetic recording disc such as a hard disc or a flexible disc, and information represented by the uneven pattern in the transfer area 10 is magnetically transferred to the track area corresponding to the transfer area 10 of the master information carrier 3, whereby a magnetization pattern representing the information is formed on the slave medium 2.

[0022]

Production of the master information carrier will be described, hereinbelow. The substrate of the master information carrier may be formed, for instance, of, nickel, silicon, quartz, glass, aluminum, alloys, ceramics, synthetic resin or the like. The uneven pattern can be formed, for instance, by the use of stamper method or photolithography.

[0023]

An example of production of the master information carrier where the uneven pattern is formed by a stamper method will be described, hereinbelow. A photoresist solution is applied to a glass plate (or quartz) having a smooth surface by spin coating, thereby forming a photoresist layer. Thereafter, a laser beam (or an electron beam) modulated according to the servo signal is irradiated, while rotating the glass plate, to expose the photoresist over the entire area thereof along the tracks in a predetermined pattern, e.g., a pattern corresponding to a servo signal radially extending from the center of rotation of the tracks to the parts corresponding to each frame on the circumference. Then, the photoresist is developed and is removed from the areas exposed to the beam, whereby an original carrying thereon an uneven pattern of the photoresist is obtained. Then plating (electroforming) is applied to the original based on the uneven pattern on the surface and a nickel substrate having a positive uneven pattern following the original is obtained. Thereafter, the nickel substrate is peeled off the original. The nickel substrate may be used as a master information carrier as it is or after forming a soft magnetic layer and/or a

protective layer on the uneven pattern as necessary.

[0024]

Otherwise, the original may be plated to form a second original and the second original may be plated to form a substrate having a negative uneven pattern. Further, a third original may be formed by plating the second original or pressing a resin syrup against the surface of the second original and curing the resin syrup, and a substrate having a positive uneven pattern may be formed by plating the third original.

[0025]

Note that an original may be obtained by etching the disc of glass after the glass plate is provided with a photoresist pattern to form holes through the glass plate and removing the photoresist. Thereafter, a substrate can be obtained from the original in the same manner as described above.

[0026]

The metal substrate may be formed of Ni or Ni alloys. The metal substrate may be formed by various metal film forming techniques including electroless plating, electroforming, sputtering, and ion plating. The depth of the uneven pattern (the height of the protrusions) of the metal substrate is preferably 50nm to 800nm, and more preferably 80nm to 600nm. The uneven pattern having the pattern of protruding portions or recessed portions is elongated in a radial direction of the master information carrier when the information to be transferred is a servo signal, and the lengths in the radial direction and the circumferential direction

are preferably in the ranges of 0.05 to 20μm and 0.05 to 5μm. It is preferred as an uneven pattern representing the information of a servo signal that the length in the radial direction is larger than that in the circumferential direction in the ranges described above.

[0027]

In the case where the substrate is of ferromagnetic material such as Ni, the magnetic transfer can be carried out with the substrate itself. However, by providing a magnetic layer which is better in magnetic transfer properties, better magnetic transfer can be carried out. In the case where the substrate of the master information carrier 3 is of non-magnetic material, it is necessary to provide a magnetic layer.

[0028]

As the magnetic layer, a soft magnetic layer or a semi-hard magnetic layer which is large in coercive force is preferred and the magnetic layer is formed by, for instance, vacuum film forming techniques such as vacuum evaporation method, sputtering or ion plating, or plating. As the specific magnetic material of magnetic layer, Co, Co alloys (e.g., CoNi, CoNiZr, or CoNbTaZr), Fe, Fe alloys (e.g., FeCo, FeCoNi, FeNiMo, FeAlSi, FeAl, or FeTaN), Ni or Ni alloys (e.g., NiFe) can be employed. FeCo and FeCoNi are especially preferred. The thickness of the magnetic layer is preferably 50nm to 500nm, and more preferably 150nm to 400nm.

[0029]

It is preferred that a 5 to 30nm thick protective film such

as of DLC (diamond-like carbon) be provided on the magnetic layer. A lubricant layer may be further provided. A reinforcement layer such as a Si layer may be provided between the magnetic layer and the protective film to enhance the contact therebetween.

[0030]

A master information carrier may be formed by forming a resin substrate by the use of the original produced in the manner described above and providing a magnetic layer on the surface of the resin substrate. As the resin material of the resin substrate, acrylic resins such as polycarbonate or polymethyl methacrylate, vinyl chloride resins such as polyvinyl chloride, or vinyl chloride copolymer, epoxy resins, amorphous polyolefins, polyesters or the like may be used. Among those, polycarbonate is preferred in view of the humidity resistance, dimensional stability, cost and/or the like. Flash on the product should be removed by varnishing or polishing. The height of the protrusions of the pattern on the resin substrate is preferably in the range of 50 to 1000nm and more preferably in the range of 200 to 500nm.

[0031]

A magnetic layer is provided over the fine pattern on the surface of the resin substrate in the similar manner, thereby obtaining a master information carrier.

[0032]

A master information carrier may be obtained, for instance, by a photolithography instead of the stamper method. For example, a photoresist layer is formed on a smooth surface of a flat substrate,

and the photoresist layer is exposed to light through a photo mask formed according to the pattern of a servo signal. Thereafter the photoresist layer is developed to obtain a pattern of photoresist corresponding to the information to be transferred, and then the substrate is etched in accordance with the patterning of photoresist to form grooves (recessed portions) in a depth corresponding to the thickness of the magnetic layer in an etching process. Then the photoresist used for patterning is removed, thereby obtaining a master information carrier substrate. A magnetic layer is provided over the fine pattern on the surface of the master information carrier substrate in the similar manner, thereby obtaining a master information carrier.

[0033]

Next, how to make the center plane mean surface roughness SRa of the contact parts 3a of the master information carrier for magnetic transfer in the range described above will be described, hereinbelow.

[0034]

Further, in the case where each substrate described above is formed, in other words, the original is formed according to the stamper method or the uneven pattern on the surface of the master information carrier substrate is formed in the steps including patterning of photoresist by lithography and removal (washing) of photoresist, residual photoresist remaining on parts which ultimately become top surfaces of the protruding portions of the substrate (or parts which ultimately become surfaces opposed to the top surfaces of the protruding portions) affects the center plane

mean surface roughness of the contact parts 3a of the master information carrier. Specifically, by enhancing the degree of washing of the photoresist, the center plane mean surface roughness SRa can be reduced. Accordingly, the center plane mean surface roughness SRa of the contact parts 3a of the master information carrier which are brought into contact with the slave medium on the top surfaces of the master information carrier can be controlled to the range described above as a result of controlling the degree of washing of the photoresist.

[0035]

When a substrate having the uneven pattern and formed by magnetic material such as Ni is employed as a master information carrier by itself, the center plane mean surface roughness SRa of the parts of such a substrate which are brought into contact with the magnetic recording medium is controlled to the range described above. Whereas, in the case where a magnetic layer and/or a protective layer is formed on the substrate having the uneven pattern on its surface, the center plane mean surface roughness SRa of the parts of the top surface of the uppermost layer which are brought into contact with the magnetic recording medium is controlled to be within the range described above.

[0036]

Figure 2 is a partial cross-sectional view of the master information carrier 3 comprising a substrate 31 having the uneven pattern on its surface and a magnetic layer 32 formed on the substrate 31. The center plane mean surface roughness SRa of the contact parts

3a can be controlled to the range described above by controlling, for instance, magnetic layer forming conditions such as the flow rate of Ar, the output power and/or the film forming thickness during sputtering at the time of forming the magnetic layer 32 on the substrate 31 having the uneven pattern on its surface.

[0037]

In the case where a protective layer and/or the like is formed on the surface of the magnetic layer, the center plane mean surface roughness SRa of the parts of the top surface of the uppermost layer which are brought into contact with the magnetic recording medium is controlled to be within the range described above.

[0038]

Further, by forming the magnetic layer and a protective layer and the like on the upper surfaces of the protruding portions of the substrate having the uneven pattern after texturing the upper surfaces of the protruding portions of the substrate having the uneven pattern by polishing, by using a laser beam, or by applying particulate material such as SiO_2, the center plane mean surface roughness SRa of the contact parts of the master information carrier may be formed to be within the range described above, as a consequence.

[0039]

When the magnetic transfer described above is carried out by the use of the master information carrier in accordance with the embodiment of the present invention described above, air is readily purged from between the master information carrier and the slave medium when they are brought into close contact with each other by

virtue of the contact parts having the predetermined center plane mean surface roughness SRa. Accordingly, favorable magnetic transfer can be carried out.

[0040]

Basic steps of magnetic transfer by the use of the master information carrier for magnetic transfer in accordance with the present invention will be described with reference to Figures 3(a) to 3(c), hereinbelow. Figure 3(a) to 3(c) shows the step of initially DC-magnetizing the slave medium by applying magnetic field in one direction, the step of applying a transfer magnetic filed in the direction opposite to the direction of the initial-DC-magnetization with the slave medium held in close contact with the master information carrier, and the state after conducting the magnetic transfer, respectively. In Figures 3(a) to 3(c), only the lower recording surface of a slave medium 2 is shown.

[0041]

An initial magnetic field Hin is first applied to the slave medium 2 in one direction parallel to the recording tracks thereof, thereby initially magnetizing the magnetic layer of the slave medium 2 in said one direction as shown in Figure 3(a). Thereafter, the information bearing side of the master information carrier 3 carrying thereon the uneven pattern is brought into a close contact with the magnetic recording surface of the slave medium 2. In this state, a transfer magnetic field Hdu is applied in the direction opposite to the initial magnetic field Hin as shown in Figure 3(b), thereby magnetically transferring the information on the master information

carrier 3 to the slave medium 2 in the track direction. As a result, information (e.g., a servo signal) corresponding to the uneven pattern of the information representing side on the master information carrier 3 is magnetically recorded on the magnetic recording surface of the slave medium 2 as shown in Figure 3(c).

[0042]

Information may be magnetically transferred to opposite sides of the slave medium 2 simultaneously or side by side in sequence.

[0043]

In the case where the uneven pattern of the master information carrier 1 representing information to be transferred is a negative pattern in an uneven pattern reverse to the positive pattern shown in Figures 3(a) to 3(c), the same information can be magnetically transferred to the slave medium 2 by reversing the directions of the initial DC magnetic field Hin and the transfer magnetic field Hdu. The intensities of the initial DC magnetic field and the transfer magnetic field are required to be determined on the basis of the coercive force of the slave medium, the specific permeabilities of the master information carrier and the slave medium, and the like.

[0044]

In this specification, the center plane mean surface roughness SRa is defined by measuring center plane mean surface roughness SRa with SPA500 available from SEIKO INSTRUMENTS in DFM mode (tapping mode) with a measuring probe AR-5 used and with the measuring range, the number of scanning lines and the scanning speed set to 2.5μm^2,

512×512 and 2Hz, respectively.

[0045]

[Experiment]

In order to prove the effect of the invention, releasability from the slave medium and the quality of the transferred signal were evaluated after the magnetic transfer using master information carriers for magnetic transfer of the present invention in accordance with specific experiments. The results are described as follows.

[0046]

The releasability was evaluated in the following manner. That is, after a slave medium was brought into contact with the master information carrier for magnetic transfer and both of them were sandwiched by a pair of plates and a certain pressure was applied to stick them together, the tensile force to separate the master information carrier and the slave medium was measured. This tensile force was employed to evaluate the releasability. Specifically, a slave medium was bonded to one of a pair of plates by adhesive and a master information carrier was held against the surface of the other of the plates by a strong magnet. Then the plates were moved toward each other so that the information side having the uneven pattern of the master information carrier and the recording surface of the slave medium are brought into contact with each other and then the master information carrier and the slave medium were sandwiched by a pair of plates and pressed against each other under a pressure equivalent to that under which they were pressed against each other to stick them together during the magnetic transfer.

Thereafter, one end of one of the plates were lifted perpendicular to the surface of the other plate about the other end of said one of the plates. The force required to separate the master information carrier and the slave medium from each other was measured by the use of a spring scale. With tensile force required to separate a master information carrier whose SRa was 0.05nm taken as 1, the releasability of the master information carrier was evaluated to be acceptable (○) when the measured tensile force was not larger than 0.3 and to be unacceptable (×) when the measured tensile force was larger than 0.3.

[0047]

The quality of the transferred signal was evaluated in the following manner. That is, distortion of the signal to be transferred to the slave medium was measured by an electromagnetic conversion property meter (SS-60 from Kyodo Electronics). An inductive head which was 0.23μm in head gap and 3.0μm in track width was used and reproduced signal (TAA) was measured. When a reproduction output not lower than 0.8mV was obtained, the quality of the transferred signal was evaluated to be acceptable (○), when a reproduction output lower than 0.8mV was obtained, the quality of the transferred signal was evaluated to be unacceptable (×).

[0048]

As for the master information carrier of the embodiments and comparative examples, the center plane mean surface roughness SRa of the contact parts which are brought into contact with the slave medium was measured with SPA500 available from SEIKO INSTRUMENTS

in DFM mode (tapping mode) with a measuring probe AR-5 used and with the measuring range, the number of scanning lines and the scanning speed set to 2.5μm^2, 512×512 and 2Hz, respectively.

[0049]

The master information carriers employed in this experiment, embodiments 1 and 2 and comparative examples 1 to 3, will be described hereinbelow.

[0050]

The master information carrier of the embodiment 1 (emb. 1) was prepared in the following manner. A photoresist layer was formed on a glass substrate and was exposed to light in a pattern representing information to be transferred. Thereafter the photoresist layer was developed and the photoresist of the exposed part was removed, whereby the glass substrate was provided on its surface with an uneven pattern of photoresist. Then the glass substrate was plated with Ni, whereby a nickel substrate having an uneven pattern on its surface was obtained. Then a magnetic layer was formed on the uneven pattern by sputtering. The sputtering conditions were 1.8W/cm^2, 133mPa (1.0mTorr) and 100nm in introduced power, Ar pressure and thickness of the magnetic layer, respectively. The master information carrier of the embodiment 1 was 0.43nm in center plane mean surface roughness SRa.

[0051]

The master information carrier of the embodiment 2 (emb. 2) was prepared in the same manner as the embodiment 1 except that the sputtering conditions were 3.0W/cm^2, 199.5mPa (1.5mTorr) and 300nm

in introduced power, Ar pressure and thickness of the magnetic layer, respectively. The master information carrier of the embodiment 2 was 9.70nm in center plane mean surface roughness SRa.

[0052]

The master information carrier of the comparative example 1 (ex. 1) was prepared in the following manner. A photoresist layer was formed on a glass substrate and was exposed to light in a pattern representing information to be transferred. Thereafter the photoresist layer was developed and the photoresist of the exposed part was removed, whereby the glass substrate was provided on its surface with an uneven pattern of photoresist. Then the glass substrate was etched using the photoresist as a mask to form holes in the glass substrate and the photoresist was removed, thereby obtaining a glass substrate having on its surface an uneven pattern. Then a magnetic layer was formed on the uneven pattern by sputtering. The sputtering conditions were $3.0W/cm^2$, 199.5mPa (1.5mTorr) and 360nm in introduced power, Ar pressure and thickness of the magnetic layer, respectively. The master information carrier of the comparative example 1 was 10.8nm in center plane mean surface roughness SRa.

[0053]

The master information carrier of the comparative example 2 (ex. 2) was prepared in the same manner as the embodiment 1 except that the sputtering conditions were $4.6W/cm^2$, 438.9mPa (3.3mTorr) and 370nm in introduced power, Ar pressure and thickness of the magnetic layer, respectively. The master information carrier of the

comparative example 2 was 21.3nm in center plane mean surface roughness SRa.

[0054]

The master information carrier of the comparative example 3 (ex. 3) was prepared in the same manner as the embodiment 1 except that the sputtering conditions were 1.0W/cm^2, 26.6mPa (0.2mTorr) and 70nm in introduced power, Ar pressure and thickness of the magnetic layer, respectively. The master information carrier of the comparative example 3 was 0.2nm in center plane mean surface roughness SRa.

[0055]

Embodiments 1 and 2 are master information carriers having center plane mean surface roughnesses SRa in the range described in this invention and comparative examples 1 to 3 are master information carriers having center plane mean surface roughnesses SRa out of the range described in this invention.

[0056]

The magnetic transfer was carried out onto the slave medium using the master information carriers of each embodiment and comparative example, and releasability and signal quality of the respective master information carriers were evaluated. The results are indicated in the following table 1.

[0057]

[Table 1]

Table 1

	SRa(nm)	releasability	signal quality

emb.1	0.43	○	○
emb.2	9.70	○	○
ex.1	10.8	○	×
ex.2	21.3	○	×
ex.3	0.20	×	○

As can be understood from table 1, the master information carriers of the embodiments 1 and 2 were acceptable in both the releasability and the signal quality, whereas, the master information carriers of the comparative examples 1 to 3 were unacceptable in one of the releasability and the signal quality.

[Brief Description of the Drawings]

Figures 1(a) and 1(b) are a plan view and a partial cross-sectional view of a master information carrier of the present invention, respectively.

Figure 2 is a fragmentary cross-sectional view of a master information carrier in accordance with a first embodiment of the present invention, and

Figures 3(a) to 3(c) are views for illustrating the basic steps of magnetic transfer.

[Explanation of the Reference Numerals]

1 slave medium

2 master information carrier

3a contact parts which are brought into contact with the slave

medium

31 substrate

32 magnetic layer

FIG.1

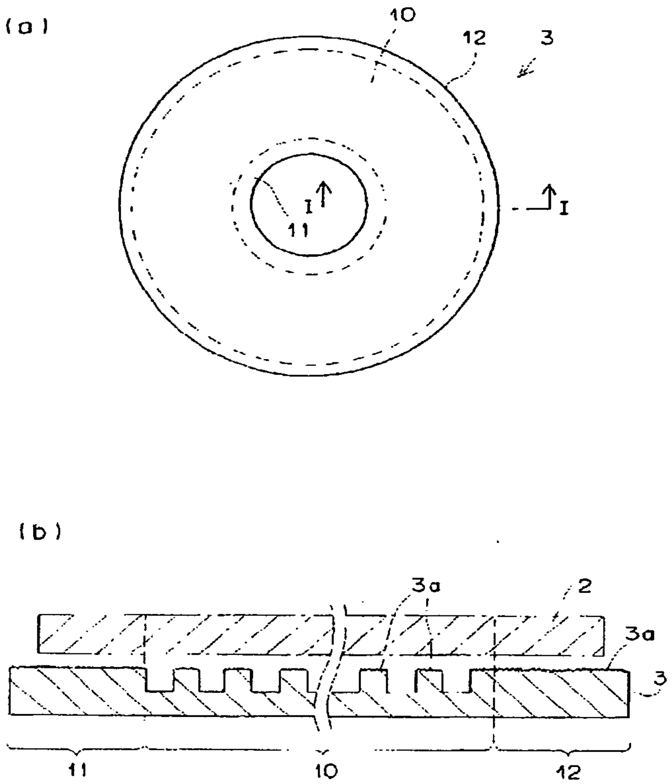


FIG.2

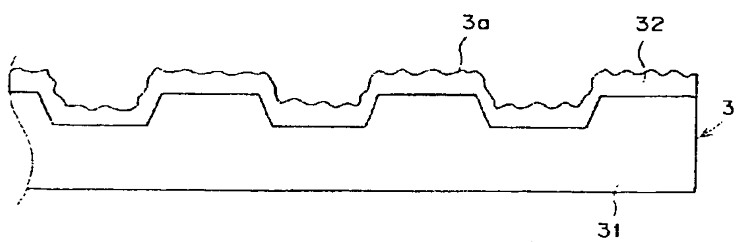
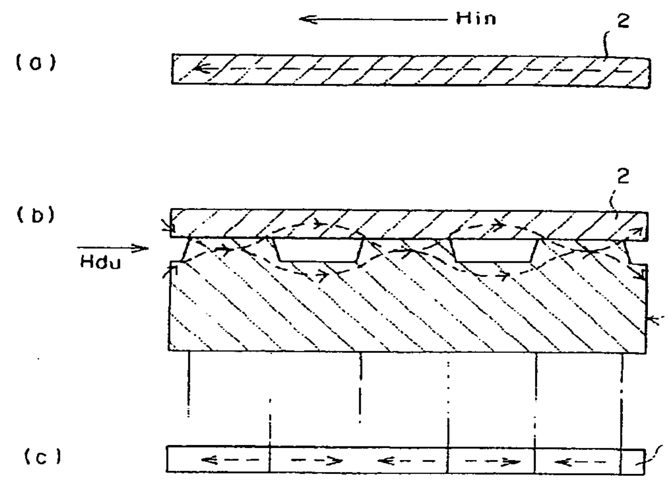


FIG.3



[Name of Document] Specification

[Abstract]

[Objective]

To obtain a good reproduction signal from a magnetic recording medium, to which information is magnetically transferred by a master information carrier for magnetic transfer.

[Constitution]

In the master information carrier 3 having on its surface an uneven pattern, corresponding to the information to be transferred to a magnetic recording medium 2, the center plane mean surface roughness SRa of the part of the surface of the master carrier 3 in contact with the magnetic recording medium 2 is set in the range of 0.3 nm to 10.0nm.

[Selected Figure] Figure 1